Robotics & Differentiated Instruction for Students with Specific Learning Disabilities

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Overview

Progressive educational strategies are becoming increasingly important to close the gap between students who perform successfully academically and those who do not achieve well, using traditional teaching methods. New, innovative strategies are being developed to target student populations which have not achieved successfully in traditional K-12 settings. Differentiated Instruction holds promise to close glaring gaps in achievements. More specifically, robotics programs can provide opportunities for student achievement and autonomy.

This paper focuses on using robotics and differentiated instruction for students who qualify for Special Education services at Oak Grove High School for grades 9-12. Students are identified as having a specific learning disability. Their IQ's have been tested and measured to be average to above average intelligence.

What is a Specific Learning Disability?

Various learning disabilities impact young learners. For example, one disability may be an auditory processing disorder (also called receptive language) or the individual might have difficulty distinguishing subtle differences in sound (called phonemes) or might have difficulty distinguishing individual phonemes. Either problem can result in an individuals difficulty of processing and understanding what is said.

Individuals might have difficulty with what is called auditory figure-ground. Those learners have difficulty identifying what sound(s) to listen to when more than one sound is presented.

Another common disorder is in the area of visual processing wherein the student may have difficulty distinguishing subtle differences in shapes (called graphemes). They may rotate or reverse letters or numbers (d, b, p, q, 6, 9) thus misreading the symbol. Some might have a figure-ground problem, confusing what figure(s) to focus on from the page covered with many words and lines. They might skip words, skip lines, or read the same line twice. Others might have difficulty blending information from both eyes to have depth perception. They may misjudge depth or distance, bumping into things or having difficulty with tasks where this information is needed to tell the hands or body what to do. If there is difficulty with visual perception, there could be problems with tasks that require eye-hand coordination (visual motor skills) such as catching a ball, doing a puzzle, or picking up a glass (**http://www.ldaamerica.org.)**

Students may also have difficulty with integration and making sense of information. Tasks such as sequencing, abstraction and organization over time (executive function) are essential to integrating information. Other SLDs involves memory deficits. "Working memory" refers to the ability to hold on to pieces of information until the pieces blend into a full thought or concept. For example, reading each word until the end of a sentence or paragraph and then understanding the full content. "Short-term memory" is the active process of storing and retaining information for a limited period of time. The information is temporarily available but not yet stored for long-term retention. "Long-term memory" refers to information that has been stored and that is available over a long period of time. Students might have difficulty with auditory memory or visual memory (**http://www.ldaamerica.org.)** In summary, learning disabilities can interfere with the learning process, thus requiring innovative teaching and learning strategies so students

can connect information with long term memory, and dissemination of information to ensure academic success.

What is Differentiated Instruction in relationship to Robotics?

Robotics is a hands-on learning experience designed to engage students in learning the practical applications of science, technology, engineering and math. Participation in the robotics program provide the opportunity for students to develop leadership, communication and organizational skills.

Differentiated instruction is a vehicle to explore and achieve high expectations for all students. It is flexible in that many tiers of instruction to challenge all students at their independent level of instructional needs; hence, "No Child Left Behind" becomes a reality. Each student is able to address State Standards as they learn new skills at the appropriate level; whether it is at the top, in the middle, or at the basic skill level. For example, to teach Rotational Geometry, Distance=Angle x Radius (D=A x R) content can be modified by using a robot. Students can visualize the process by using different thinking processes to problem solve and produce an end product. By using a hands-on approach we have taken the student characteristics of learning and their interests into account. The building of the robot and completion of mathematical equations is determined by the students' readiness to advance to the next level and affords the opportunity for accelerated learning. By using a project oriented method the student is provided with open-ended activities. It also promotes flexible grouping, teamwork, and combines teacher and student choices.

How to make it work.

Differentiated instruction addresses the reality that children learn differently and

at different rates of progress. Teachers know what to teach by using state standards as a guideline, however, it is the use of differentiated instruction that guides teaching all children through modification of curriculum objectives. Brain and intelligence research reinforces the concept that how we learn and what defines Intelligence is compatible with theories regarding differentiated instruction and utilizing the Zone of Proximal Development (ZPD) This theory, developed by psychologist Lev Vygotsky, illustrates, the difference in student achievement between what students can do as independent learners and what they can do with teacher assistance. The region in which learning outcomes are maximized is at the "appropriate level of complexity" (Vygotsky, 1964)

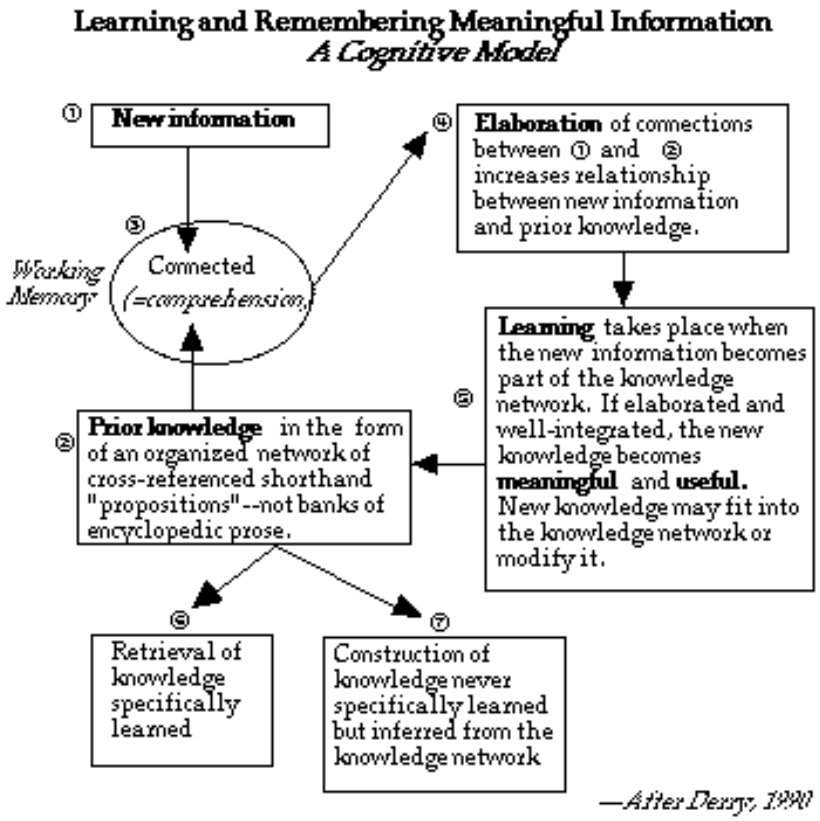
Research shows that brain cell growth is directly affected by enrichment activity:

- Brain stimulation by reading and writing.
- Physical activity or motor stimulation by doing something new.
- New dendritic connections are formed by problem solving imitating brain growth.
- The arts stimulate academic and social skills.
- Multi-faceted arrangements of classrooms, colors and pictures that induce a safe environment promote brain growth.

(Jensen, 2005)

This is a cognitive model of learning as shown that can be visualized by **Figure 1.**

Figure 1



(Grow. 1994)

Meeting Students Needs Through Robotics

Using robotics in the classroom provides the opportunity for the teacher to provide feedback at various stages in a project. A teacher, for example, may:

- focus learners' attention on important features of the new information, correct their first impressions, help them recall relevant knowledge, and build motivation.
- help learners elaborate the new knowledge so it becomes interconnected, memorable, and useful.
- identify and correct misconceptions or introduce helpful concepts and vocabulary.
- elicit strategies from students, or teach strategies helpful for different kinds of reading (e.g., scanning, reading headings, analyzing an argument).
- evaluate students' assimilated knowledge to see how accurate and complete and useable it is, then make assignments to correct deficiencies (Grow, 1996).

For special education students, a hands-on robotic curriculum can inspire an interest in science and increase self-esteem, as well as teach basic life skills such as collaborative problem solving, decision making, goal setting and logical thinking.

Acceleration of specific skills for every student

Robots are a great aid to the teaching of specific skills and concepts especially in maths and physics because of their power to capture the imagination of all students, including those with specific learning disabilities. Thus they can be employed to make clear often difficult abstract concepts. With the robot as the focus of the discussion, a wide range of topics can be brought to life: Newtonian mechanics; measurement; task planning; programming; mathematical formulation of a problem; optimization; limits; etc. Giving something physical in the 3-dimensional "real world" can help many special education students grasp the fundamentals of a topic more quickly than just using paper/white board and pen. The robot as well as assisting in conceptualization of a problem, provides an environment for experimentation. Possible solutions can be programmed into the robot and then its behavior observed to see if it conforms to that which the student expected. There is then opportunity for integration towards a correct solution to a particular problem. Thus the power of discovery in effective learning can be readily facilitated through the use of a robot as a teaching aid in the special education classroom (Cooper, Keating, Harwin & Dautenhahn, 1999).

References

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Learning Disabilities Association of America. Retrieved May 27, 2007, from http://www.ldaamerica.org LDA is the largest non-profit volunteer organization advocating for individuals with learning disabilities and has over 200 state and local affiliates in 42 states and Puerto Rico. LDA's international membership of over 15,000 includes members from 27 countries around the world. The membership, composed of individuals with learning disabilities, family members and concerned professionals, advocates for the almost three million students of school age with learning disabilities and for adults affected with learning disabilities.

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